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Trajectories of Psychosocial Problems in Adolescents Predicted by Findings From Early Well-Child Assessments

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A B S T R A C T

Purpose: To describe trajectories of emotional and behavioral problems in adolescents and to identify early indicators of these trajectories using data from routine well-child assessments at ages 0–4 years.
Methods: Data from three assessment waves of adolescents (n = 1,816) of the TRAILS were used (ages: 11–17 years). Information on early indicators (at ages 0–4 years) came from the records of the well-child services. Trajectories of emotional and behavioral problems were based on the parent-reported Child Behavior Checklist and the adolescent-reported Youth Self-Report, filled out at ages 11, 14, and 17 years. Multinomial logistic regression analysis was used to examine the predictive value of these early indicators on trajectories.
Results: For boys and girls, we found four trajectories for each outcome: one with high problem levels, and three with middle-high, middle-low, and low levels. For emotional problems, the type of trajectory was predicted by parental educational level and parental divorce or single parents, for both genders. Moreover, sleep problems were predictive in boys and language problems in girls (odds ratios between 1.53 and 7.42). For behavioral problems, the type of trajectory was predicted by maternal smoking during pregnancy, parental educational level, and parental divorce or single parents, for both genders. Moreover, for boys, early behavioral problems and attention hyperactivity problems were predictive (odds ratios between 1.64 and 5.43).
Conclusions: Trajectories of emotional and behavioral problems during adolescence are rather stable and can be predicted by a parsimonious set of data from early well-child assessments.

IMPLICATIONS AND CONTRIBUTION

Research results on trajectories of emotional and behavioral problems are rather heterogeneous. Our results show that trajectories of emotional and behavioral problems during adolescence are remarkably stable and can be predicted by a parsimonious set of data from early well-child assessments.

Emotional and behavioral problems are prevalent during childhood and adolescence. Although patterns vary across ages, the underlying aspects are rather stable, which limits the value of studies at a single point in time [1,2]. Therefore, studying the trajectories of emotional and behavioral problems has been recommended [3]. So far, trajectory studies have looked at the disorder level [2,4,5] and not at the broad range of emotional and behavioral problems, whereas indicated prevention mostly targets children with increased problems levels [6].

Evidence on trajectories of emotional and behavioral problems is rather heterogeneous, with some studies showing only

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slight-to-moderate variation in problem levels [2,7] and others showing rather large variation over time [2,4,8]. Evidence on gender differences is lacking, but these are likely to occur. First, prevalence rates differ by gender, depending on the type of problems [9,10]. Second, girls have been shown to develop relatively more emotional problems during adolescence than boys [5,9].

Well-child care, or preventive child health care, aims to identify children at risk for various problems, including emotional and behavioral ones, especially the more severe problem behavior. In particular, preschool age has been shown to be very important for children's further development and functioning [11,12]. However, evidence on early indicators that discriminate between different trajectories is scarce, with previous studies measuring an outcome at a single time point [13–16], focusing on disorders, and/or assessing parental and peer relationships as predictors [7,17–19].

Community-based well-child services are uniquely positioned for the early identification of children at risk for psychosocial problems. In The Netherlands, well-child professionals provide health and developmental monitoring to the entire Dutch population from birth until young adulthood [20]. However, evidence is lacking on the degree to which the findings of these well-child services are predictive for trajectories of emotional and behavioral problems in adolescents. The aim of the present study is to describe these trajectories of emotional and behavioral problems in adolescents and to identify early indicators of these trajectories using data from routine well-child assessments.

Methods

Sample

TRAILS is a prospective cohort study of Dutch preadolescents and adolescents [21]. The present study used data from the first (n = 2,230; mean age = 11.09; standard deviation [SD] = .56), second (n = 2,149, mean age = 13.55; SD = .54), and third (n = 1,819, mean age = 16.26; SD = .73) waves. Parents of 2,139 children (96%) gave written informed consent to retrieve data from the well-child records. Of these, well-child files of 1,816 children (84.9%) could be traced. Children with and without a well-child file differed with regard to the prevalence of parent-rated behavioral problems (14.4% for those with retrievable well-child files vs. 20.0% for those with nonretrievable well-child files, $p < .05$) but did not differ statistically with regard to parent-rated emotional problems (16.6% vs. 18.2%, respectively, $p > .05$) at T1. The TRAILS study was approved by the Dutch National Medical Ethics Committee.

Emotional and behavioral problems: Outcomes

Emotional and behavioral problems were assessed using the adolescent-reported Youth Self-Report (YSR) and the parent-reported Child Behavior Checklist (CBCL) at each wave. The validity of both instruments has been documented extensively [22,23]. They consist of 120 questions about the previous 6 months, each coded as 0 = not true, 1 = somewhat/sometimes true, and 2 = very/often true. "Emotional problems" involve the anxious/depressed, somatic complaints, and withdrawn/depressed syndrome scales. "Behavioral problems" involve the aggressive behavior and delinquent behavior syndrome scales. Multi-informant information is known to be a better predictor of disorder than single-informant information [24,25]. Therefore, we computed the average of the scores on the YSR and CBCL, giving equal weight to both informants.

Early development

Data on early development were obtained from well-child records, in which information from all well-child visits had been recorded. These visits are provided free of charge; covering approximately 95% of the population. Between ages 0 and 4 years, 12 visits, on average, are provided by community physicians and nurses (well-child professionals). The assessments include a general physical examination, standardized screening procedures, and a semistructured interview with parents concerning health status and physical, emotional, and behavioral developmental problems, all of which are documented in the well-child file. An assessment generally takes approximately 10–15 minutes. In accordance with the literature, we selected all the potentially relevant factors from the well-child file: prenatal and perinatal factors, early motor and social development, and family characteristics [13–16,26–28].

Prenatal and perinatal risks. Maternal smoking and alcohol use were assessed by two questions: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?" [26]. Low birth weight was defined as a birth weight of <2,500 g [28]. Gestational age was registered in weeks. The aforementioned questions were not only part of the well-child files, but were also part of the T1 interview in TRAILS (when a child was 11 years old). If answers for these questions were missing in the well-child file, then we enriched our data with the data from TRAILS. Birth complications included abruption, preterm rupture, meconium in amniotic fluid, and preeclampsia, and they were dichotomized as "yes" if any of these were present, or "no" if none were present.

Early motor and social development. Early motor and social development, from birth to 4 years of age, were assessed using four indices. The first was the Van Wiechen schema, which is the Dutch equivalent of the Bayley scales, at ages 1–15 months [27]. These indicators were divided into three different subcategories: gross motor skills (16 items), fine motor skills and adaptation (11 items), and communication and social behavior (10 items); each of them was targeted toward children of a predetermined age. The items were summed within these three subcategories and then dichotomized as "yes" if any problems were present, or "no" if otherwise.

Second, the well-child professional assessed problems in motor and language development at six occasions between ages 18 months and 4 years. Examples of these developmental problems are delays in motor skills and speech delay. Findings were then dichotomized as "yes" if any problems were present during one or more of these six occasions, or "no" if otherwise.

Third, from age 18 months to 4 years, the well-child professional systematically asked parents about sleeping and eating behavior. The responses were dichotomized as "yes" if any of these problems were present during one or more of the six visits, or "no" if otherwise.

The fourth index concerned well-child-registered behavioral features, noted at six assessments between the ages of 18 months and 4 years. Parental disclosures concerning playing,

behavior, and social behavior were systematically assessed and recorded by well-child professionals using short descriptions such as "overactive," "shy," "anxious," or "aggressive" (see Jaspers et al [29]). These were categorized as behavioral problems, emotional problems, attention hyperactivity problems, social problems in behavior, or positive behavior and were then dichotomized as "yes" if any of these were present during the six occasions, or "no" if otherwise.

Family characteristics. Parental educational level, based on the parent with the highest level, was allocated to three levels: low (at the lowest levels of secondary education), medium (higher levels of secondary education), and high (higher vocational or university degree). If both answers were missing for the well-child file we enriched the data with the data from TRAILS. The living situation was classified into two groups: living with both biological parents versus living with divorced parents, stepparent(s), or single parents.

Analyses

Multiple imputation of missing data. To prevent missing data in our indicators, we combined data on several visits, and, if that was not possible, we supplemented missing values by retrospectively collecting information at T1 (n = 1,816 well-child files). At the assessment waves, 5.6% at T1 to 34.2% at T3 had missing data for the subscales of the YSR and the CBCL. These were imputed based on the multivariate normal model [30], as implemented in the NORM software (NORM version 2.03, NORM, London, United Kingdom). This procedure minimizes the loss of statistical power, provides correctly estimated standard errors, and preserves the characteristics of the data set as a whole [31]. It is based on the assumption that, given the observed data, missing values are random [31]. However, violations have been shown to have only minor effects [32], and, if any, these were further reduced by using all observed information in a multivariate imputation model in which possible relations between missing values and observed data are modeled [33].

All missing values were imputed 10 times to achieve good efficiency of estimation and sufficient statistical power [30,31]. The imputed data sets were then pooled to build trajectories in which the results (from the mean of the 10 data sets) were combined to obtain estimates of parameters and standard errors. These estimates then correctly reflected both sampling variability and the additional uncertainty owing to missing data and imputation.

Statistical analyses. First, we computed trajectories for each adolescent using latent class regression analyses on the data for all three measurement waves, done separately for boys and girls. The trajectories were constructed from the mean of the 10 imputed data sets. Boys and girls differed with regard to the mean scores on emotional and behavioral problems during a majority of the measurements. Statistically significant differences regarding emotional problems were at T2 YSR (girls higher), T3 YSR (girls higher), and T3 CBCL (girls higher), and regarding behavioral problems at T1 CBCL (boys higher), T2 CBCL (boys higher), and T3 YSR (boys higher). Latent class regression analysis enables groups of individuals to be categorized into mutually exclusive classes based on their trajectories, followed by their responses to a single outcome variable over time. Because the outcome variables concerned count data, Poisson regression models were used that allowed overdispersion in a negative binomial distribution. To determine the optimal number of classes, the Bayesian information criterion was used (Table A1) [34], which yielded four categories that we labeled as a high trajectory of adolescents with problem levels in the clinical range, and a middle-high, a middle-low, and a low trajectory.

Next, we used multinomial logistic regression analysis to assess the relationship between early developmental indicators and trajectories, again separately for boys and girls. A multinomial logistic regression model with four outcomes is roughly equivalent to running three binary logistic regressions, except that all parameters are estimated simultaneously, which enables the predictive power of independent variables to be assessed across all outcome levels [35]. These analyses were performed in two steps. First, we assessed the crude effect of each variable on the outcomes separately. We had chosen these variables based on the available evidence on which variables might be predictive, and on whether data on these variables were recorded in routine well-child files. All variables with an association at $p < .20$ were used in the second step. In the second step, we constructed a final model using backward regression with $p < .05$ as the criterion regarding the contribution of each variable. The statistical analyses were performed using Latent GOLD (Latent GOLD version 4.5, Latent GOLD, Belmont, MA) and SPSS version 16 (SPSS version 16, SPSS, Chicago, IL).

Results

Figure 1 shows the trajectories of emotional and behavioral problems for girls and boys. Of the 932 girls, 80 (8.6%) were in the trajectory of clinical emotional problems, whereas 20 of the 884 boys (2.3%) were in this group. In the clinical behavioral group, there were 39 girls (4.2%) and 76 boys (8.6%) (see Figure 1).

Table 1 shows crude and mutually adjusted odds ratios (ORs) for the relation between well-child predictors and the four groups of trajectories, for emotional and for behavioral trajectories, in both girls and boys during adolescence. For the group of trajectories of emotional problems in girls, the significant predictors were language and speech problems, having divorced or single parents, and having parents with a low educational level (ORs between 2.72 and 7.42). Estimates of the associations of language and speech problems with this group of trajectories were rather inaccurate, indicated by fairly wide confidence intervals and unstable estimates. Therefore, we repeated the analyses without this predictor. Instead, early emotional problems were included as a predictor in the model. For the group of trajectories of emotional problems in boys, the identified predictors were maternal smoking during pregnancy, early sleep problems, and having parents with a low or medium educational level (ORs between 1.53 and 5.43), whereas maternal alcohol use during pregnancy was a protective predictor in the emotional model (OR = .63).

Predictors for the group of trajectories of behavioral problems in girls were maternal smoking during pregnancy, having divorced or otherwise single parents, and having parents with a low or medium educational level (ORs between 1.69 and 5.41), whereas gross motor problems were a protective predictor (OR = .44). Attention hyperactivity problems did not contribute to the model. For the group of trajectories of behavioral problems in boys, maternal smoking during pregnancy, early behavioral problems, attention hyperactivity problems, the absence of any positive reported behavior, a low level of parental education, and

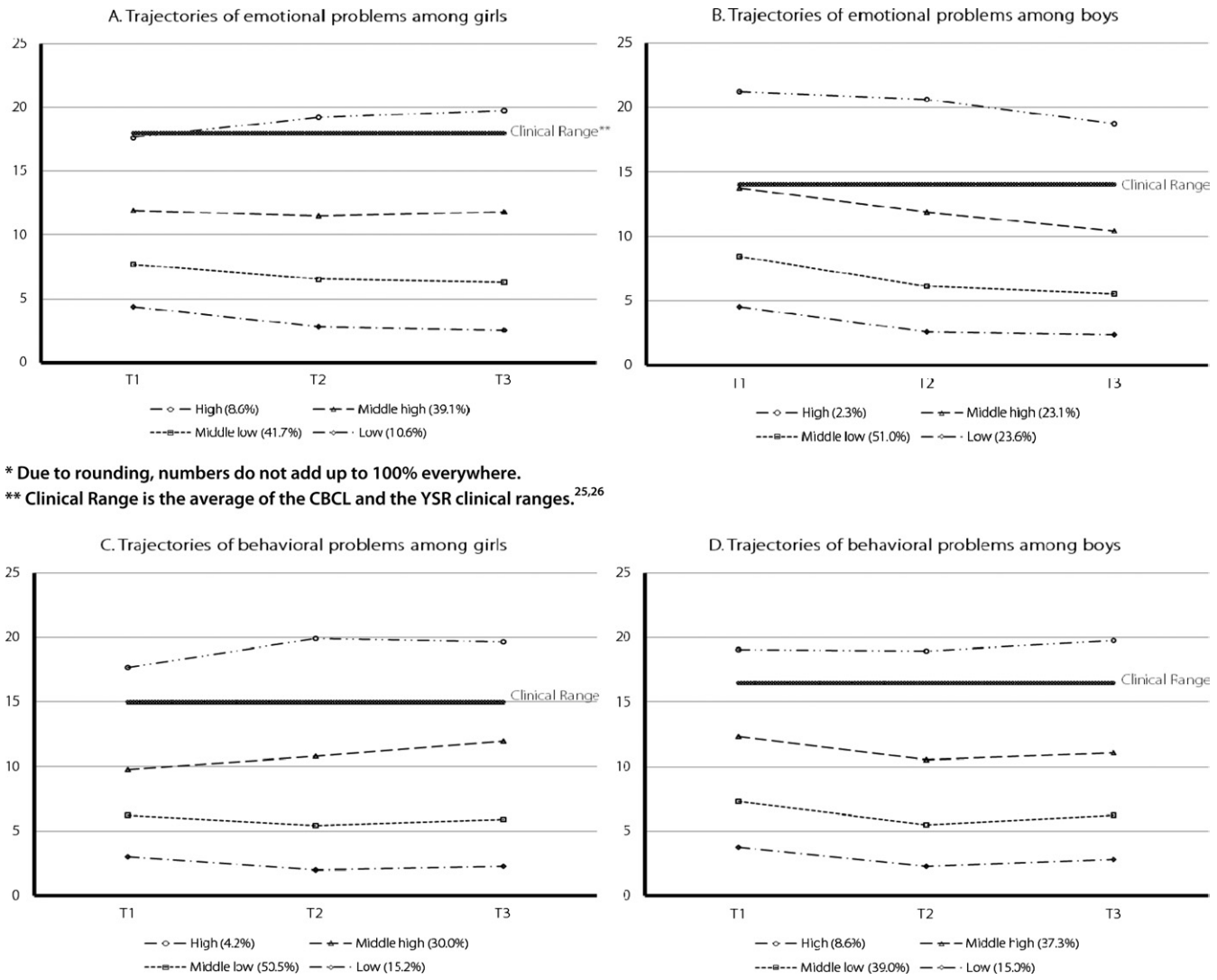

Figure 1. (A–D): Trajectories of emotional and behavioral problems among girls and boys.

having divorced or otherwise single parents were predictors (ORs between 1.59 and 4.25).

Discussion

This study is the first to assess early indicators for trajectories of emotional and behavioral problems in adolescents, based on data from routine well-child assessments in a large longitudinal community-based sample. We identified groups of four trajectories, similarly for both genders and for emotional and behavioral problems. Each group comprised a high trajectory of clinical problems, and a middle-high, a middle-low, and a low trajectory. All trajectories were relatively stable across ages; the continuity of these problems was very high. Parsimonious sets of early childhood indicators from well-child assessments predicted each of these groups of trajectories. For both genders, all sets comprised low and medium parental educational levels and having divorced or otherwise single parents. For trajectories of emotional problems, sleep problems were a unique predictor in boys and language problems in girls. For both genders, groups of trajectories of behavioral problems were predicted by maternal smoking during pregnancy. In addition, in boys, early behavioral problems and attention hyperactivity problems were predictive.

We found that trajectories were rather stable, with only slight-to-moderate increases or decreases in problem levels. This is in line with the findings of Dekovic et al [7] regarding emotional problems. Letcher et al [8] found more variability in trajectories of emotional problems, but they mostly measured the anxiety dimension and not the whole spectrum of emotional problems. Regarding behavioral problems, Nagin and Tremblay [4] found four trajectories for physical aggression, opposition, and hyperactivity among boys. There was a chronic problem trajectory; a middle-high and a middle-low trajectory, both of which desisted over time; and a no-problem trajectory.

Based on our findings, one might conclude that community-based assessments at age 11 already provide most of the information needed to identify groups with higher rates of problems. However, caution is needed, as developmental trajectories groups summarize the average behavioral trend at the group

Table 1
Multinomial logistic regression on level of emotional and behavioral problems for adolescents

Emotional problems for girls							
N = 932	High problems n = 80 (8.6%)		Middle-high problems n = 364 (39.1%)		Middle-low problems n = 389 (41.7%)		Low problems n = 99 (10.6%)
Variable	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	1.23 (.62–2.49)		.88 (.51–1.53)		.90 (.53–1.55)		1
Maternal smoking during pregnancy	1.30 (.69–2.44)		1.25 (.77–2.02)		1.03 (.63–1.67)		1
Low birth weight (<2,500 g)	.48 (.09–2.55)		1.45 (.54–3.88)		1.35 (.50–3.60)		1
Birth complication	.97 (.49–1.94)		.89 (.53–1.51)		.81 (.48–1.36)		1
Early motor and social development							
Gross motor skills delay (age: 1–15 months)	.72 (.36–1.44)		**.58 (.35–.97)**		**.56 (.35–.98)**		1
Fine motor skills delay	.82 (.22–3.00)		.85 (.33–2.20)		1.20 (.48–2.99)		1
Communication delay	2.28 (.64–8.08)		1.31 (.44–3.94)		1.56 (.53–4.61)		1
Motor problems (age: 1.5–4 years)	3.93 (.77–20.0)		3.27 (.76–14.1)		1.41 (.31–6.47)		1
Language and speech problems	**6.93 (1.47–32.61)**	**7.42 (1.56–35.31)**	2.67 (.61–11.67)	2.78 (.63–12.21)	3.05 (.71–13.15)	3.12 (.72–13.49)	1
Sleep problems	1.27 (.66–2.45)		.82 (.49–1.38)		.97 (.58–1.61)		1
Problems with eating	.91 (.50–1.64)		1.36 (.87–2.13)		1.18 (.76–1.84)		1
Behavioral problems	1.40 (.76–2.58)		1.10 (.68–1.76)		1.03 (.64–1.65)		1
Emotional problems	**2.06 (1.02–4.20)**		.93 (.52–1.69)		1.11 (.62–1.99)		1
Social problems in behavior	.82 (.22–3.00)		1.09 (.43–2.76)		.71 (.27–1.85)		1
Attention hyperactivity problems	.86 (.45–1.62)		.88 (.55–1.41)		.85 (.53–1.36)		1
No positive behavior reported	1.44 (.79–2.63)		1.11 (.79–1.75)		1.25 (.79–1.96)		1
Family characteristics							
Low educational level of parents	**2.60 (1.01–6.73)**	**2.47 (1.03–5.91)**	1.26 (.64–2.50)	1.42 (.74–2.73)	1.78 (.92–3.44)	1.85 (.98–3.50)	1
Middle educational level of parents	**2.79 (1.31–5.95)**	**2.27 (1.11–4.62)**	1.37 (.82–2.29)	1.26 (.77–2.07)	1.11 (.67–1.85)	1.10 (.67–1.81)	1
Divorced parents or one parent	**3.17 (1.39–7.21)**	**3.04 (1.32–7.00)**	**3.05 (1.53–6.12)**	**2.73 (1.35–5.51)**	**2.06 (1.02–4.15)**	1.76 (.86–3.58)	1
Emotional problems for boys							
N = 884	High problems n = 20 (2.3%)		Middle-high problems n = 204 (23.1%)		Middle-low problems n = 451 (51.0%)		Low problems n = 209 (23.6%)
Variable	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	.48 (.14–1.71)	.47 (.13–1.74)	.86 (.55–1.35)	.96 (.60–1.53)	**.55 (.37–.82)**	**.63 (.42–.95)**	1
Maternal smoking during pregnancy	1.33 (.49–3.64)	1.23 (.40–3.72)	**2.04 (1.34–3.11)**	**1.82 (1.17–2.81)**	1.34 (.92–1.95)	1.25 (.85–1.84)	1
Low birth weight (<2,500 g)	1.78 (.20–15.57)		2.30 (.86–6.18)		1.16 (.45–3.04)		1
Birth complication	2.02 (.76–5.37)		.97 (.61–1.56)		1.20 (.80–1.78)		1
Early motor and social development							
Gross motor skills delay (age: 1–15 months)	.99 (.32–3.13)		.93 (.57–1.51)		1.08 (.72–1.62)		1
Fine motor skills delay	2.46 (.64–9.40)		1.12 (.53–2.39)		1.25 (.66–2.36)		1
Communication delay	1.11 (.24 (5.16)		.69 (.33–1.44)		1.08 (.62–1.90)		1
Motor problems (age: 1.5–4 years)	—		2.55 (.88–7.37)		1.40 (.50–3.92)		1
Language and speech problems	.86 (.11–7.01)		1.78 (.85–3.75)		1.25 (.63–2.49)		1
Sleep problems	**4.86 (1.89–12.49)**	**5.43 (2.05–14.40)**	**1.62 (1.03–2.55)**	**1.64 (1.03–2.60)**	1.44 (.97–2.15)	1.35 (.90–2.04)	1
Problems with eating	1.49 (.59–3.73)		**1.74 (1.18–2.57)**		**1.55 (1.11–2.16)**		1
Behavioral problems	1.86 (.74–4.67)		1.46 (.99–2.16)		1.03 (.74–1.44)		1
Emotional problems	1.10 (.30–3.97)		1.11 (.64–1.92)		1.34 (.84–2.12)		1
Social problems in behavior	1.34 (.29–6.29)		1.10 (.54–2.23)		1.30 (.72–2.37)		1
Attention hyperactivity problems	.66 (.25–1.80)		1.32 (.90–1.96)		1.22 (.88–1.71)		1
No positive behavior reported	**3.42 (1.26–9.21)**		1.35 (.91–1.99)		1.26 (.90–1.76)		1
Family characteristics							
Low educational level of parents	.50 (.10–2.40)	.74 (.19–2.52)	1.43 (.82–2.50)	1.49 (.86–2.58)	**1.94 (1.21–3.10)**	**1.70 (1.07–2.69)**	1

Table 1
Continued

Emotional problems for boys							
N = 884	High problems n = 20 (2.3%)		Middle-high problems n = 204 (23.1%)		Middle-low problems n = 451 (51.0%)		Low problems n = 209 (23.6%)
Variable	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	Reference group
Middle educational level of parents	.54 (.16–1.79)	.57 (.18–1.80)	**1.65 (1.04–2.62)**	**1.63 (1.02–2.59)**	**1.75 (1.18–2.59)**	**1.53 (1.04–2.27)**	1
Divorced parents or one parent	2.35 (.79–6.99)		**2.11 (1.25–3.56)**		**1.71 (1.06–2.74)**		1
Behavioral problems for girls							
N = 932	High problems n = 39 (4.2%)		Middle-high problems n = 280 (30.0%)		Middle-low problems n = 471 (50.5%)		Low problems n = 142 (15.2%)
Variable	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	.89 (.34–2.37)		1.26 (.74–2.13)		1.33 (.81–2.17)		1
Maternal smoking during pregnancy	**2.35 (1.13–4.87)**	1.56 (.73–3.35)	**1.94 (1.25–3.01)**	**1.69 (1.06–2.70)**	.99 (.65–1.51)	.94 (.60–1.46)	1
Low birth weight (<2,500 g)	.71 (.15–3.40)		.70 (.30–1.61)		1.00 (.48–2.07)		1
Birth complication	.81 (.31–2.14)		1.27 (.76–2.11)		1.36 (−.85 to 2.19)		1
Early motor and social development							
Gross motor skills delay (age: 1–15 months)	.42 (.16–1.07)	.43 (.17–1.13)	**.43 (.26–.70)**	**.44 (.27–.73)**	**.51 (.34–.79)**	**.51 (.33–.79)**	1
Fine motor skills delay	.31 (.04–2.51)		.97 (.45–2.06)		.64 (.31–1.34)		1
Communication delay	.91 (.18–4.45)		.69 (.30–1.74)		1.26 (.57–2.80)		1
Motor problems (age: 1.5–4 years)	3.94 (.94–16.56)		1.68 (.54–5.25)		1.61 (.54–4.77)		1
Language and speech problems	2.20 (.61–7.96)		1.17 (.47–2.91)		1.17 (.50–2.75)		1
Sleep problems	2.09 (.97–4.51)		1.42 (.88–2.29)		1.05 (.66–1.65)		1
Problems with eating	1.09 (.54–2.22)		1.27 (.85–1.91)		1.34 (.92–1.95)		1
Behavioral problems	1.59 (.76–3.35)		1.42 (.91–2.20)		1.34 (.89–2.02)		1
Emotional problems	1.10 (.46–2.66)		.84 (.50–1.42)		1.03 (.64–1.67)		1
Social problems in behavior	.91 (.18–4.45)		1.36 (.59–3.15)		.74 (.32–1.73)		1
Attention hyperactivity problems	**2.13 (1.01–4.73)**		1.50 (.95–2.36)		1.31 (.85–2.01)		1
No positive behavior reported	1.79 (.88–2.66)		1.20 (.80–1.82)		.99 (.68–1.46)		1
Family characteristics							
Low educational level of parents	**5.50 (1.59–19.03)**	**5.41 (1.76–16.64)**	1.19 (.65–2.20)	1.44 (.81–2.55)	1.10 (.63–1.90)	1.33 (.78–2.24)	1
Middle educational level of parents	**4.55 (1.41–14.62)**	**3.90 (1.33–11.45)**	**1.80 (1.09–2.97)**	**1.82 (1.13–2.94)**	1.29 (.81–2.04)	1.38 (.89–2.13)	1
Divorced parents or one parent	**3.62 (1.68–7.78)**	**3.17 (1.43–7.03)**	**1.71 (1.03–2.84)**	1.57 (.91–2.68)	.96 (.58–1.57)	.97 (.58–1.63)	1
Behavioral problems for boys							
N = 884	High problems n = 76 (8.6%)		Middle-high problems n = 330 (37.3%)		Middle-low problems n = 345 (39.0%)		Low problems n = 133 (15.0%)
Variable	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	Reference group
Prenatal and perinatal factors							
Maternal alcohol use during pregnancy	.73 (.33–1.62)		1.48 (.88–2.48)		1.28 (.76–2.16)		1
Maternal smoking during pregnancy	**4.34 (2.25–8.37)**	**2.76 (1.37–5.59)**	**3.02 (1.79–5.12)**	**2.63 (1.53–4.52)**	**2.51 (1.50–4.25)**	2.36 (1.38–4.04)	1
Low birth weight (<2,500 g)	.87 (.21–3.58)		1.22 (.47–3.15)		.50 (.17–1.45)		1
Birth complication	.78 (.40–1.50)		.83 (.53–1.32)		.70 (.44–1.11)		1
Early motor and social development							
Gross motor skills delay (age: 1–15 months)	.87 (.43–1.80)		.93 (.56–1.53)		1.10 (.67–1.80)		1
Fine motor skills delay	.86 (.28–2.62)		1.14 (.54–2.42)		.99 (.47–2.12)		1
Communication delay	1.01 (.38–2.70)		1.12 (.56–2.24)		.82 (.40–1.67)		1

Table 1
Continued

Behavioral problems for boys							
N = 884	High problems n = 76 (8.6%)		Middle-high problems n = 330 (37.3%)		Middle-low problems n = 345 (39.0%)		Low problems n = 133 (15.0%)
Variable	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	OR (crude) 95% CI	OR (adj)[a] 95% CI	Reference group
Motor problems (age: 1.5–4 years)	.28 (.33–2.39)		.66 (.23–1.86)		.96 (.37–2.54)		1
Language and speech problems	.97 (.31–3.01)		1.14 (.51–2.49)		1.12 (.51–2.46)		1
Sleep problems	1.47 (.76–2.86)		1.50 (.91–2.45)		1.63 (1.00–2.66)		1
Problems with eating	1.14 (.65–2.01)		1.38 (.92–2.07)		1.36 (.91–2.03)		1
Behavioral problems	**2.54 (1.42–4.55)**	**2.06 (1.10–3.86)**	**1.87 (1.23–2.86)**	**1.80 (1.16–2.80)**	1.48 (.97–2.26)	1.46 (.94–2.25)	1
Emotional problems	.64 (.28–1.47)		.94 (.55–1.60)		.95 (.56–1.61)		1
Social problems in behavior	.86 (.31–2.41)		.97 (.48–1.97)		1.03 (.51–2.07)		1
Attention hyperactivity problems	**2.10 (1.18–3.71)**	**2.06 (1.10–3.86)**	1.31 (.87–1.97)	1.26 (.81–1.94)	1.09 (.72–1.64)	1.07 (.70–1.64)	1
No positive behavior reported	**1.92 (1.09–3.41)**	1.83 (.98–3.42)	**1.56 (1.03–2.35)**	**1.59 (1.03–2.45)**	1.26 (.77–1.74)	1.20 (.78–1.83)	1
Family characteristics							
Low educational level of parents	**5.51 (2.13–14.25)**	**3.97 (1.60–9.83)**	1.55 (.88–2.73)	1.03 (.58–1.82)	1.16 (.66–2.03)	1.03 (.59–1.79)	1
Middle educational level of parents	**4.55 (1.88–11.00)**	**3.48 (1.48–8.20)**	**1.66 (1.03–2.67)**	1.37 (.85–2.20)	1.32 (.83–2.10)	1.24 (.78–1.97)	1
Divorced parents or one parent	**6.47 (2.99–14.02)**	**4.25 (1.10–3.86)**	**3.10 (1.58–6.05)**	**2.58 (1.16–2.80)**	**2.10 (1.07–4.16)**	1.85 (.92–3.70)	1

OR = odds ratio; CI = 95% confidence interval.
Criterion $p < .20$ for inclusion in multivariate model. Values in bold indicate that these values have fulfilled the criteria of statistical significance ($p < .20$ univariately and $p < .05$ multivariately) and a confidence interval in which the value 1 does not appear.
[a] Adj = adjusted for all other variables that are included in the multivariate model.

level. Not all individuals' behavioral trajectories will exactly match the group average [36]. Moreover, trajectories on broad groups of problems, such as emotional and behavioral, might not show much variety, whereas the compositing symptoms might do so.

We found gender differences in the prevalence of these two broadband problems: girls experienced more emotional problems and boys experienced more behavioral problems, as has been found in many other studies [7,8,10,17]. Moreover, although overall relatively stable, problems increased by approximately 10% between ages 11 and 17 years for girls in the clinical trajectory of emotional problems (from an average of 17.7–22.2), whereas there was a decrease for boys in this trajectory.

The predictors that we found for our trajectories of emotional and behavioral problems are partly in line with previous studies that measured predictors at the same time as the trajectories [4,8] and/or focused on parental and peer relationships [7,17–19]. In line with Letcher et al, we found that toddler emotional problems (including shyness) were predictive for a high emotional trajectory; however, this was only predictive after removing the factor of language problems from our analyses. We did not replicate the finding of Letcher et al [8] that early behavioral problems were predictive for high rates of adolescent emotional problems. Surprisingly, we also did not replicate the findings of Leve et al that early behavioral and attention hyperactivity problems were predictive for adolescent behavioral problems in girls [37].

Our findings confirm the impact of early social disadvantage on adolescent emotional and behavioral problems, whereas previous findings were mixed [8,38]. We found that having a parent with a low and a medium educational level was predictive for groups of trajectories in both boys and girls, with a high trajectory of behavioral problems for boys and a high trajectory of emotional problems for girls. Previously, we developed and validated a prediction model for emotional and behavioral problems in preadolescence (T1 data) [29]. In that study, we partially found the same predictors (as in this study), mainly regarding behavioral problems. Maternal smoking during pregnancy, low and medium parental educational level, and having divorced parents or a single parent were predictive for both genders, with high trajectories of behavioral problems.

Strengths and limitations

Major strengths of our study concern its prospective nature, spanning many years from birth onward, its high response rate, and its embedding in routine community-based well-child care. Moreover, we used a broad range of indicators, whereas most previous studies only used subsets of indicators; emotional and behavioral problems were identified based on both child and parent ratings, thereby reducing measurement error.

Our study also has some limitations that may have led to underestimation of the predictive power of the well-child findings. First, children may have received effective treatment for their psychosocial problems between the ages of 4 and 11 years in early intervention programs. Well-child care professionals have been shown to undertake action in 85% of the cases in which they identify psychosocial problems, including an intended referral for further diagnostics and treatment in 20% [22]. This may have led to some reduction of problems in adolescence, thereby lowering the predictive power of early well-child findings.

Second, some highly predictive early-risk indicators may not have been identified as indicators owing to their low prevalence. Third, we did not control for parental psychopathology. Some indicators, such as smoking during pregnancy and low socioeconomic status, might be associated with genetically determined

higher levels of behavioral problems on the part of the parents [39], implying that causal inferences should be made cautiously. Fourth, the CBCL and YSR questionnaires may also be subject to error in terms of the identification of relevant children, which would decrease the predictive power of indicators. For instance, for the CBCL, the sensitivity and specificity of the Dutch version, in terms of the cutoff for clinical range, are .66 and .82, respectively [23].

Our findings have several implications for well-child services. First, they support the importance of prevention of smoking during pregnancy [26]. Second, they show the value of early childhood monitoring to identify children at risk for trajectories of high rates of emotional and behavioral problems. Third, given the continuity of emotional and behavioral problems, they also show the importance of continued monitoring during adolescence.

This study is the first to assess the predictive power of early well-child findings on adolescent trajectories of emotional and behavioral problems, implying that its results need to be confirmed. This should also comprise trajectories of co-occurring emotional and behavioral problems, given the frequent occurrence of these [40].

In conclusion, trajectories of emotional and behavioral problems during adolescence are remarkably stable and can be predicted by a parsimonious set of data from early well-child assessments. The well-child setting may play an important role in prevention by monitoring children at risk for developing these stable problems, by administering diagnostic instruments to further qualify their symptoms, and by providing early treatment if needed.

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References

[1] Kraemer HC, Yesavage JA, Taylor JL, Kupfer D. How can we learn about developmental processes from cross-sectional studies, or can we? Am J Psychiatry 2000;157:163–71.
[2] Bongers IL, Koot HM, van der Ende J, Verhulst FC. Developmental trajectories of externalizing behaviors in childhood and adolescence. Child Dev 2004;75:1523–37.
[3] Costello EJ, Angold AC. Developmental epidemiology: A framework for developmental psychopathology. In: Sameroff AJ, Lewis M, eds. Handbook of developmental psychopathology. New York, NY: Kluwer Academic/Plenum, 2000:57–73.
[4] Nagin D, Tremblay RE. Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. Child Dev 1999;70:1181–96.
[5] Hankin BL. Development of sex differences in depressive and co-occurring anxious symptoms during adolescence: Descriptive trajectories and potential explanations in a multiwave prospective study. J Clin Child Adolesc Psychol 2009;38:460–72.
[6] Durlak JA, Wells AM. Primary prevention mental health programs for children and adolescents: A meta-analytic review. Am J Community Psychol 1997;25:115–52.
[7] Deković M, Wissink IB, Meijer AM. The role of family and peer relations in adolescent antisocial behaviour: Comparison of four ethnic groups. J Adolesc 2004;27:497–514.
[8] Letcher P, Smart D, Sanson A, et al. Psychosocial precursors and correlates of differing emotional trajectories from 3 to 15 years. Soc Dev 2009;18:618–46.
[9] Costello EJ, Mustillo S, Erkanli A, et al. Prevalence and development of psychiatric disorders in childhood and adolescence. Arch Gen Psychiatry 2003;60:837–44.
[10] Zahn-Waxler C, Klimes-Dougan B, Slattery MJ. Internalizing problems of childhood and adolescence: Prospects, pitfalls, and progress in understanding the development of anxiety and depression. Dev Psychopathol 2000;12:443–66.
[11] Keating DP, Hertzman C. Developmental health and the wealth of nations: Social, biological, and educational dynamics. New York, NY: Guilford Publications, 1999.
[12] Kershaw P, Irwin L, Trafford K, Hertzman C. The British Columbia atlas of child development. Victoria, BC: Western Geographic Press, 2006.
[13] Glascoe FP. Screening for developmental and behavioral problems. Ment Retard Dev Disabil Res Rev 2005;11:173–9.
[14] Mesman J, Koot HM. Early preschool predictors of preadolescent internalizing and externalizing DSM-IV diagnoses. J Am Acad Child Adolesc Psychiatry 2001;40:1029–36.
[15] Najman JM, Heron MA, Hayatbakhsh MR, et al. Screening in early childhood for risk of later mental health problems: A longitudinal study. J Psychiatr Res 2008;42:694–700.
[16] Ong SH, Wickramaratne P, Tang M, Weissman MM. Early childhood sleep and eating problems as predictors of adolescent and adult mood and anxiety disorders. J Affect Disord 2006;96:1–8.
[17] Montague M, Cavendish W, Enders C, Dietz S. Interpersonal relationships and the development of behavior problems in adolescents in urban schools: A longitudinal study. J Youth Adolesc 2010;39:646–57.
[18] Galambos NL, Barker ET, Almeida DM. Parents do matter: Trajectories of change in internalizing and externalizing problems in early adolescence. Child Dev 2003;74:578–94.
[19] Scaramella LV, Conger RD, Simons RL. Parental protective influences and gender-specific increases in adolescent emotional and behavioral problems. J Res Adolesc 1999;9:111–41.
[20] Brugman E, Reijneveld SA, Verhulst FC, Verloove-Vanhorick SP. Identification and management of psychosocial problems by preventive child health care. Arch Pediatr Adolesc Med 2001;155:462–9.
[21] Huisman M, Oldehinkel AJ, de Winter AF, et al. Cohort profile: The Dutch "tracking adolescents' individual lives' survey"; TRAILS. Int J Epidemiol 2008;37:1227–35.
[22] Achenbach TM, Rescorla LA. Manual for the Achenbach system empirically based assessment (ASEBA), preschool forms and profiles. Burlington, VT: University of Vermont, Research Center for children, youth and families, 2001.
[23] Verhulst FC, Van der Ende J, Koot HM. Manual for the CBCL/4–18 (Handleiding voor de CBCL/4–18). Rotterdam, Netherlands: Erasmus University, Department of Child and Adolescent Psychiatry, Sophia Children's Hospital, 1996.
[24] Achenbach TM, McConaughy SH, Howell CT. Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. Psychol Bull 1987;101:213–32.
[25] Verhulst FC, Van der Ende J. Agreement between parents' reports and adolescents' self-reports of problem behavior. J Child Psychol Psychiatry 1992;33:1011–23.

[26] Ashford J, van Lier PA, Timmermans M, et al. Prenatal smoking and internalizing and externalizing problems in children studied from childhood to late adolescence. J Am Acad Child Adolesc Psychiatry 2008;47:779–87.
[27] Jacobusse G, Van Buuren S, Verkerk PH. An interval scale for development of children aged 0–2 years. Stat Med 2006;25:2272–83.
[28] Kohn MA, Vosti CL, Lezotte D, et al. Optimal gestational age and birthweight cutoffs to predict neonatal morbidity. Med Decis Making 2000;20:369–76.
[29] Jaspers M, de Winter AF, de Meer G, et al. Early findings of preventive child healthcare professionals predict psychosocial problems in preadolescence: The TRAILS study. J Pediatr 2010;157:316–21.
[30] Rubin DB. Multiple imputation for nonresponse in surveys. New York, NY: Wiley, 1987.
[31] Graham JW. Missing data analysis: Making it work in the real world. Annu Rev Psychol 2009;60:577–605.
[32] Collins LM, Schafer JL, Kam CM. A comparison of inclusive and restrictive strategies in modern missing data procedures. Psychol Methods 2001;6:330–51.
[33] Schafer JL. Multiple imputation in multivariate problems when the imputation and analysis models differ. Stat Neerl 2003;57:19–35.
[34] Vermunt JK, Magidson J. Latent GOLD 4.0 user's guide. Belmont, MA: Statistical Innovations, Inc, 2005.
[35] Long JS, Cheng S. Regression models for categorical outcomes. In: Hardy M, Bryman A, eds. Handbook of data analysis. London, United Kingdom: Sage Publications Ltd, 2004:259–84.
[36] Tremblay RE, Nagin DS, Seguin JR, et al. Physical aggression during early childhood: Trajectories and predictors. Can Child Adolesc Psychiatry Res 2005;14:3–9.
[37] Leve LD, Kim HK, Pears KC. Childhood temperament and family environment as predictors of internalizing and externalizing trajectories from ages 5 to 17. J Abnorm Child Psychol 2005;33:505–20.
[38] Strohschein L. Parental divorce and child mental health trajectories. J Marriage Fam 2005;67:1286–300.
[39] Buschgens CJ, Swinkels SH, van Aken MA, et al. Behavioral behaviors in preadolescents: Familial risk to behavioral behaviors, prenatal and perinatal risks, and their interactions. Eur Child Adolesc Psychiatry 2009;18:65–74.
[40] Pesenti-Gritti P, Spatola CA, Fagnani C, et al. The co-occurrence between internalizing and externalizing behaviors. Eur Child Adolesc Psychiatry 2008;17:82–92.

Appendix

Table A1
Fit statistics

Fit statistics for latent class analysis models					
Group	Class	Solution	Number of parameters	Log-likelihood	Bayesian information criterion[a]
Female	3	Emotional	14	−9,946.74	19,991.93
	4		19	−9,916.77	**19,967.14**
	5		24	−9,908.55	19,985.87
Male	3	Emotional	14	−8,986.64	18,071.29
	4		19	−8,949.81	**18,032.64**
	5		24	−8,943.32	18,054.67
Female	3	Behavioral	14	−9,372.08	18,842.59
	4		19	−9,309.80	**18,753.20**
	5		24	−9,302.42	18,773.59
Male	3	Behavioral	14	−9,423.90	18,945.82
	4		19	−9,392.21	**18,917.44**
	5		24	−9,378.94	18,925.91

[a] Best model is indicated in bold.